

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

1. (Original) A flexible PTC heating element comprising:

an electrode formed by printing,

a PTC resistor formed by printing and supplied with electric power from the electrode,

a flexible substrate impregnated with a portion of the electrode and a portion of the PTC resistor, and

a flexible cover material covering at least the electrode and the PTC resistor and joined with the flexible substrate.

2. (Original) The flexible PTC heating element according to claim 1, wherein

the flexible substrate has:

a non-woven fabric and

an impregnation control member for controlling the degree of impregnation of conductive paste forming the electrode and PTC ink forming PTC resistor to the non-woven fabric.

3. (Original) The flexible PTC heating element according to claim 2, wherein

the impregnation control member is one of a resin coating material and a hot melting film.

4. (Original) The flexible PTC heating element according to claim 2, wherein

the non-woven fabric is made of heat resistant fibers capable of maintaining a shape at the melting point of the impregnation control member.

5. (Original) The flexible PTC heating element according to claim 1, wherein

the flexible cover material has adhesiveness at least with the flexible substrate.

6. (Original) The flexible PTC heating element according to claim 1, wherein

a concave/convex cross sectional shape is formed over an entire surface.

7. (Original) The flexible PTC heating element according to claim 6, wherein

the concave/convex cross sectional shape is formed by one of embossing fabrication and stitching fabrication.

8. (Original) The flexible PTC heating element according to claim 1, wherein

the flexible substrate is provided with an opening.

9. (Original) The flexible PTC heating element according to claim 2, wherein

the non-woven fabric is an orthogonal fiber non-woven fabric in which long fibers are arranged in a direction along which the flexible PTC heating element extends.

10. (Original) The flexible PTC heating element according to claim 2, wherein

a conductive wire incorporated in at least one axial direction of the non-woven fabric is further provided and

the conductive wire functions as a portion of the electrode.

11. (Original) The flexible PTC heating element according to claim 1, wherein

the flexible substrate includes one of a flexible mesh substrate having a deformable opening and ink impregnating property, and a flexible fiber substrate having a deformable opening and ink impregnating property.

12. (Original) The flexible PTC heating element according to claim 11, wherein
the flexible substrate further includes a flexible support substrate joined with
the flexible mesh substrate and having ink impermeability.
13. (Original) The flexible PTC heating element according to claim 11, wherein
the opening of one of the flexible mesh substrate and the flexible fiber
substrate is formed in a rhombic shape.
14. (Original) The flexible PTC heating element according to claim 11, wherein
an orthogonal fiber type non-woven fabric is used by being bias cut as one of
the flexible mesh substrate and the flexible fiber substrate.
15. (Original) The flexible PTC heating element according to claim 11, wherein
the flexible substrate contains an ink impermeable flexible barrier material
which is impregnated and retained in a film-like shape in one of the flexible mesh
substrate and the flexible fiber substrate.
16. (Original) The flexible PTC heating element according to claim 15, wherein
the flexible barrier material is composed of a hot melting film and is capable
of maintaining a shape at a drying temperature of the conductive paste forming the
electrode and the PTC ink forming the PTC resistor.
17. (Original) The flexible PTC heating element according to claim 15, further
comprising:
a knit mesh with restriction for elongation, joined between one of the flexible
mesh substrate and the flexible fiber substrate, and the flexible barrier material, and
restricting the elongation of one of the flexible mesh substrate and the flexible fiber
substrate.
18. (Original) The flexible PTC heating element according to claim 11, wherein

at least one of the electrode and the PTC resistor is formed while leaving an opening in one of the flexible mesh substrate and the flexible fiber substrate and the flexible cover material covers an entire portion.

19. (Original) The flexible PTC heating element according to claim 1, wherein

the flexible substrate is composed of a first fiber substrate joined with a flexible resin film, and

the flexible cover material is composed of a second fiber substrate joined with a hot melting resin film thermally fused with one of the flexible resin film and the first fiber substrate.

20. (Original) The flexible PTC heating element according to claim 19, wherein

the flexible resin film includes at least one of olefin, urethane and styrene thermoplastic elastomers.

21. (Original) The flexible PTC heating element according to claim 20, wherein

the flexible resin film further includes an adhesive resin.

22. (Original) The flexible PTC heating element according to claim 19, wherein

the first fiber substrate and the second fiber substrate are composed of at least one of:

one of a non-woven fabric and a first knit with a load at 5% lateral elongation of 7.5 kgf or less and a load at 5% longitudinal elongation of 7.5 kgf or more, and

a second knit with a load at each 5% longitudinal and lateral elongation of 7.5 kgf or less and, having a rhombic opening and extending by deformation.

23. (Original) A flexible PTC heating element comprising:

an electrode formed by printing,

a PTC resistor formed by printing and supplied with electric power from the electrode,

a flexible substrate composed of one of resin foam having a concave/convex shape on the surface, and a rubber material having a concave/convex shape on the surface, the flexible substrate being provided with the electrode and the PTC resistor thereon, and

a flexible cover material covering at least the electrode and the PTC resistor and joined with the flexible substrate.

24. (Original) The flexible PTC heating element according to claim 23, wherein

the flexible substrate further includes a resin net bonded with one of the resin foam and the rubber material.

25. (Currently Amended) A flexible PTC heating element comprising:

a flexible substrate having ink impermeability, an electrode formed from conductive paste on the flexible substrate,

a PTC resistor formed from PTC ink and supplied with electric power from the electrode,

a flexible cover material for covering the electrode and the PTC resistor, and

an elongation deformation portion disposed to at least one of the electrode and the PTC resistor.

26. (Original) The flexible PTC heating element according to claim 25, wherein

the electrode is in a comb-like shape having a main electrode and a branch electrode electrically connected with the main electrode and the PTC resistor, and

the elongation deformation portion is the branch electrode formed in a corrugated shape.

27. (Original) The flexible PTC heating element according to claim 25, wherein

the elongation deformation portion is a PTC resistor fiber formed by impregnating the PTC ink to a deformable fiber material having an opening, and the PTC resistor fiber is used as the PTC resistor.

28. (Original) The flexible PTC heating element according to claim 25, wherein

the elongation deformation portion is an uncoated portion of a rhombic shape provided to the PTC resistor.

29. (Original) The flexible PTC heating element according to claim 25, wherein

the elongation deformation portion is the electrode and the PTC resistor formed by impregnation into a mesh-like fiber substrate having an opening.

30. (Original) The flexible PTC heating element according to claim 29 further comprising, a flexible resin film joined to a surface of the mesh-like fiber substrate opposite to the surface impregnated with the electrode and the PTC resistor.

31. (Currently Amended) The flexible PTC heating element according to claim 25, wherein

the elongation deformation portion is the electrode and the PTC substrate resistor formed on a flexible resin film joined on a mesh-like fiber substrate having an opening.

32. (Original) The flexible PTC heating element according to any one of claims 1, 23 and 25, wherein

the electrode is in a comb-like shape having a main electrode and a branch electrode electrically connected with the main electrode and the PTC resistor, and

an elongation control portion for controlling the elongation of at least the main electrode in the longitudinal direction is provided.

33. (Original) The flexible PTC heating element according to claim 32, wherein

the elongation control portion is composed of a knitted shape resin net.

34. (Original) The flexible PTC heating element according to any one of claims 1, 23 and 25, further comprising an elongation control portion for controlling the elongation of at least one of the flexible substrate and the flexible cover material.

35. (Original) A flexible PTC heating element comprising:

an electrode formed by printing,

a PTC resistor formed by printing and supplied with electric power from the electrode,

a flexible substrate having the electrode and the PTC resistor formed on the surface and having adhesiveness, and

a flexible cover material covering at least the electrode and the PTC resistor and joined with the flexible substrate, wherein

at least one of the flexible substrate and the flexible cover material has an elongation control portion.

36. (Original) The flexible PTC heating element according to any one of claims 1, 23, 25 and 35, further comprising:

a moisture absorber having an opening, the moisture absorber being thermally in contact with the PTC resistor.

37. (Original) The flexible PTC heating element according to any one of claims 1, 23, 25 and 35, wherein

the electrode is in a comb-like shape having a main electrode and a branch electrode electrically connected with the main electrode and the PTC resistor,

wherein the flexible PTC heating element has an elongation in the longitudinal direction of the main electrode of more than 0% and at most 3% under a load of 5 kgf, and an elongation in the longitudinal direction of the branch electrode of at least 3% and at most 10% under a load of 5 kgf, and has a breaking strength of at least 15 kgf.

38. (Original) The flexible PTC heating element according to claim 1, wherein

the flexible cover material contains at least one of:

resin coating material,

a non-woven fabric attached with a hot melting film,

resin foam coated with an adhesive,

rubber material coated with an adhesive,

a leather, and

an artificial leather.

39. (Original) A flexible PTC heating element according to any one of claim 1, 23, 25 and 35, wherein

a through hole penetrating from a back surface to a front surface of the flexible heating element is formed.

40. (Original) The flexible PTC heating element according to any one of claims 1, 23, 25 and 35, further comprising a terminal portion electrically connected at one end with the electrode and electrically connected at another end with a lead wire,

wherein the flexible cover material covers the terminal portion.

41. (Original) The flexible PTC heating element according to claim 40, wherein

the terminal portion has:

a conductive thin material and

a conductive adhesive material for joining one end of the conductive thin material and the electrode.

42. (Original) The flexible PTC heating element according to claim 40, further comprising an adhesive non-woven fabric for fixing the terminal portion, wherein

the flexible cover material covers the adhesive non-woven fabric.

43. (Original) The flexible PTC heating element according to claim 40, wherein
the terminal portion is disposed on the surface of the flexible substrate and a portion of the electrode is formed so as to overlap one end of the terminal portion.

44. (Original) The flexible PTC heating element according to claim 40, wherein
the terminal portion is disposed in the flexible substrate, and a portion of the electrode is provided to one end of the terminal portion in a manner that a conductive paste forming the electrode is coated above the flexible substrate.

45. (Original) The flexible PTC heating element according to claim 43, wherein
the terminal portion has a pattern-formed cream solder at a position where the electrode is printed.

46. (Original) The flexible PTC heating element according to claim 40, wherein
the terminal portion has an unsoldered portion electrically connected with the electrode and a soldered portion connected with the lead wire passing through the flexible cover material.

47. (Previously Presented) The flexible PTC heating element according to any one of claim 1, 23, 25 and 35, wherein

the flexible substrate includes:

a first flexible substrate and

a second flexible substrate having a cushioning substrate with ink impregnating property for dispersing and retaining in a non-film shape, wherein

the PTC resistor is provided on the second flexible substrate,

the electrode is formed on the first flexible substrate,

the electrode and the PTC resistor are electrically contacted, and

the flexible cover material covers an entire portion.

48. (Original) The flexible PTC heating element according to any one of claims 1, 23, 25 and 35, wherein

at least one of the electrode and the PTC resistor contains one of a resin and an elastomer as a binder.

49. (Original) The flexible PTC heating element according to any one of claims 1, 23, 25 and 35, wherein

the electrode contains silver and carbon.

50. (Original) The flexible PTC heating element according to any one of claims 1, 23, 25 and 35, wherein

the PTC resistor contains a kneaded and crosslinked product of crystalline resin and carbon black, and elastomer.

51. (Original) A method of manufacturing a flexible PTC heating element comprising steps of:

- A) filling resin at least to a deformable opening in a flexible mesh substrate,
- B) forming an electrode and a PTC resistor supplied with electric power from the electrode by printing on the flexible mesh substrate,
- C) removing the resin, and
- D) covering an entire portion with a flexible cover material.

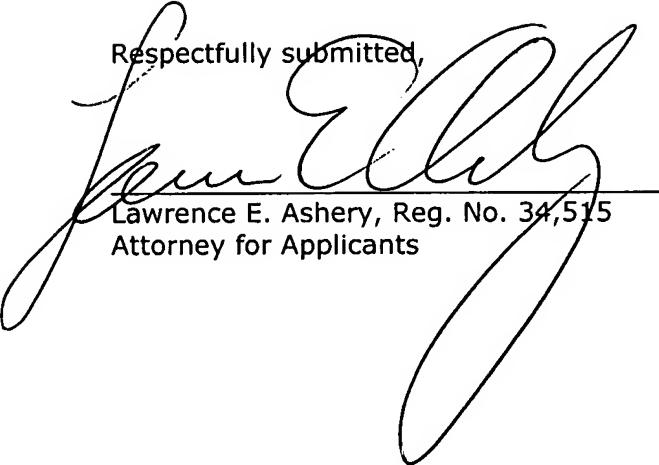
52. (Original) The method of manufacturing a flexible PTC heating element according to claim 51, wherein

the resin has one of water soluble property and water disintegrating property and applied with a water treatment in the step C.

53. (Original) The method of manufacturing a flexible PTC heating element according to claim 51, wherein

the resin includes one of polyvinyl alcohol and carboxymethyl cellulose.

Respectfully submitted,


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